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Manufacture and Evaluation of an Alternative Feeds Production Machine

El-Sheikha, A. M.[1*]; M. A. Al-Rajhi[2] and Hagar A. Amer[1]

[1]Agric. Eng. Dept., Faculty of Agriculture, Damitta Univ., Egypt
[2]Agric. Eng. Research institute, Agric. Research Center, Egypt

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ABSTRACT

The main objectives of this research are to fabricate a machine for producing a special feed with an easy operating system, that is suitable for small breeders, with low operating costs and high productivity, as well as substitution of barley grains in the feed components by sprouted barley in order to reduce costs and to increase amount of green feed and percentage of protein. The fabricated machine consisted of four main units; power and power transmission unit; chopping unit; mixing unit and pelletizing unit. Experiments were conducted to test the fabricated machine under three levels of moisture content for sprouted barley (70.09, 79.71 and 81.35 %); three different die holes' diameters (4, 6 and 8 mm); and three mixing times (10, 15 and 20 minutes). The results indicated that the mean bulk density was 443.3 Kg/m^3. The mean shear force was 0.68 N. The mean vertical and horizontal rupture forces were 3.04 and 4.11 N, respectively. The mean machine productivity was 31.78 kg/hr. The mean mixing efficiency was 81.14 %. The mean pelletizing efficiency was 75.75 %. The mean specific energy requirement 74.47 Kw.hr/Mg. The chemical analysis of produced pellets indicated that ash content was 9.1 %, protein was 21.26 % and fat was 1.98 %, so it is recommended to use the fabricated machine for producing alternative feed.

Keywords: sprouted barley, chopping, mixing, pelletizing, alternative feeds.

INTRODUCTION

Feed manufacturers usually select ingredients that are the least cost but still meet the desired nutritive properties as sprouted barley, which consider a good source of protein, carbohydrate, minerals and vitamins. Feed availability, new feed ingredients and new feeding practices have played important roles in the concentration of animal food production operations (Church, 1991; Naik and Singh, 2013) said that in the hydroponic system, the green fodder is harvested in about seven days..) The reviewed researches are divided into some topics. First topic is focused on the use of sprouted barley in feed ingredients, as a small amount of barley grains yields about 4 times from the sprouted barley with little cost and effort. Secondly, the benefits of feed cutting are examined. More clearly, quality of sprouted barley is improved by physical treatments includes chopping, shredding, grinding and pelleting (Mathers and Otchere, 2012 .(Also, knife mills or choppers work successfully for shredding forages under various crops and machine conditions .Disc mills produce very small particles if input feed is provided by knife mills or hammer mills (Hoque *et al.*, 2007). The range of cutting crop (1-3 cm) is suitable for small animals while the range of 3-5 cm is suitable for large animals (Church, 1991). However, using sprouted barley as alternative feed can solve serious problems of animal feeding shortage in Egypt. Chopping material in pieces less than 3 cm improves its efficiency when used in feeding livestock (El-Berry *et al.*, 2001). Last topic concerns the development of feed cutting devices .The results for an improved designed cutting machine for rice straw and maize stalks indicated that the maximum percentages (87.80 and 92%) in cutting length of less than 5 cm were obtained for rice straw and corn stalks residues, respectively, at cutting speed of 10.09 m/s, feeding rate of 0.771 ton/h and knife clearance of 1.5 mm while the energy consumed was 6.36 and 6.17 kWh /ton). (El-Iraqi and El-Khawaga, 2003; Ikubanni *et al.* 2019) reported that there are various types and forms of pelletizing equipments. They are varying from their dimensions, shapes, process, operation (manual or automatic), capability and function. The processes of this machines are: grinding, mixing and extrusion (Regupathi *et al*., 2019). Balami *et al.* (2013) designed, evaluated and tested an animal feed mixing machine using a feed portion divided into three equal steps. The machine was tested for four mixing period of 10, 15 and 20 minutes. The mixing efficiency was 95.16 %, when the mixing time was 10 minutes. Leman *et al.* (2017) suggested a continuous mixer to increase mixing efficiency with a shorter mixing process time. Ojomo *et al.* (2010) illustrated that as the speed of the machine increases, the efficiency of the machine increases. Orisaleye *et al.* (2009) mentioned that the pelleting die is necessary to limit the flow and supply of feed material and the pellet's cylindrical form. Abubakre *et al.* (2014) designed motorized mechanical feed pelletizer machine and reported that the machine efficiency was increased by increasing die size. Orisaleye *et al.* (2009) designed a livestock feed machine. The density of pellets was varied from 0.7 to 1 g/cm^3. The bulk density of the pellets determines the required storage space in the feed manufacturing units and also during transport. The size, shape and filling method influence the bulk density of the pellets (Ighodalo *et al.* 2020). Khater et al. (2014) showed that physical and mechanical properties of fish feed pellets such as bulk density, durability, moisture content and crushing load were varied from 267.11 to 711.35 Kg/cm^3, 70.66 to 92.62 %, 16.68 to 17.82% and 6.13 to 33.28 N, respectively. Orisaleye *et al.* (2009) cleared that average

[*] **Corresponding author.**
E-mail address: elsheikd_12000@yahoo.com
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specific energy consumption when using 750 cm^3 of starch binder was 0.69 kW.h/Kg, while it was 0.93 kW.h/Kg when water was used as preconditioner.

Thus, the main objectives of the current research are to investigate the production of alternative feeds using newly developed mixing and making machine and to minimize the operating cost of produced feeds.

MATERIALS AND METHODS

Experiments were carried out at faculty of Agriculture – Damietta University. The machine was designed for chopping, mixing and pelletizing raw materials to produce alternative fodder.

Raw materials

Barley (Giza 132) was grown in trays (30 x 70 cm) for about 7 to 9 days after being purified and sifted. The composition percentages of the experimental rabbit diets used for rabbit pelletizing machine is shown in Table 1.

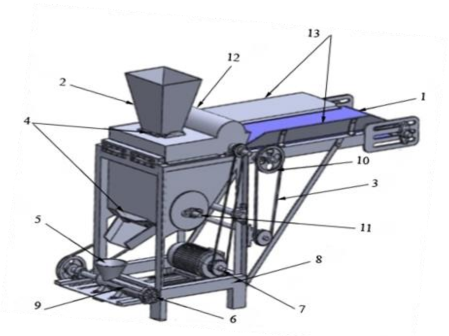
Table 1. The composition percentages of the experimental rabbit diets

S/N	FEED INGREDIENTS	(%)
1	Wheat bran	20
2	Sprouted barley	20
3	Soybean meal	15
4	Yellow maize	10
5	Dried alfalfa	30
6	Limestone	1
7	Sodium chloride	0.3
8	Dicalciamphosphate	1.25
9	Anti-toxin	0.1
10	Anti-cococidia	0.05
11	Molasses	2
12	Premix	0.3

The new fabricated machine

The new fabricated machine consists of the following parts as follows:

1) **Power source:** An electric motor [3 Hp (2.2 KW), 8.7 A, 220/380 V and 1400 rpm] was used. Power is transmitted from a pulley (70 mm diameter) on the main motor shaft to a pulley (80 mm diameter) on the cutting blades shaft, to a pulley (200 mm diameter) on mixing levers shaft, to a pulley (190 mm diameter) on the feeding belt shaft and to a pulley (190 mm diameter) on pelletizing unit shaft by mains of five V belts (Figure 1).



Object No.	Description	Object No.	Description	Object No.	Description
1	Feeding belt	5	Pelletizing unit	9	Auger
2	Hooper	6	Die	10	Pulley
3	Cutting belt	7	Motor	11	Mixing unit
4	Gates	8	Chassis	12	Cutting blades
				13	cover

Figure 1. Power and power transmutation system

2) **Chassis:** The chassis [0.75×0.38×0.17 m length× width× height] is made from L shape iron (6 cm) which welded and manufactured locally to stand tracking on its own four wheels 12 cm diameter. The fabricated machine has dimensions of 1.42×0.55×1.2 m length× width× height as shown in the schematic drawing Figure 2.

3) **The cutting unit**: As shown in Figure 3, an inside cutter drum have the cutting action for the transmitted feed to the unit .It is provided with an inlet feeding belt (1200 mm length and 250 mm width) with two edges. Four cutting blades (250 mm length and 60 mm width) were used for cutting sprouted barley at a speed of 1260 rpm (6.6 m/s) to produce cutting length of about 2.67 cm.

4) **Feeding hooper:** The feeding hopper was made from steel sheet (2 mm thickness, 240 mm height, 180x180 mm upper opening and 10x10 mm lower opening). The feeding hopper provided with a gate at the bottom to control the amount of feeding material. The maximum capacity of the feeding hopper was 20 Kg.

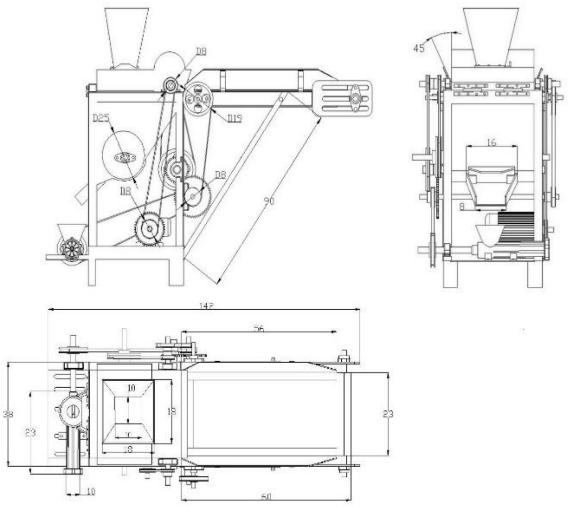


Figure 2 . Schematic drawing for the fabricated machine

Figure 3. Cutting unit

5) **The mixing unit :**as shown in Figure 4, pieces of barley were mixed with the other composition in a mixing room by using 4 mixing levers (260 mm length and 40 mm width), which rotates clockwise on a main shaft to ensure the homogeneous mixture. It holds up to 30 Kg of mixture and provided with a cover to prevent some lightweight ingredients "powder” from skipping in the opposite direction. Rotational speed of levers was 267 rpm (1.4 m/s). At the end of the mixing unit there was a gate that opens at the end of the specified time to push the ingredients to the pelleting phase.

Figure 4. Mixing unit

6) The pelletizing unit: The pelletizing unit consists of a screw conveyor (230 mm length, 100mm in diameter and pitch of 40 mm). Rotational speed of screw conveyor was 263.18 rpm (2.62 m/s). A forming die was assembled in die house by bolts 10 mm diameters. The outer diameter of all dies were 100 mm and 10 mm thickness. There are three types of die, die 4 mm hole diameter which has 57 holes in its surface ,die 6 mm hole diameter which has 48 holes in its surface and die 8 mm hole diameter which has 33 holes in its surface as shown in the Figure 5. The actual final side and front views of the fabricated machine are presented in Figure 6 and Figure 7.

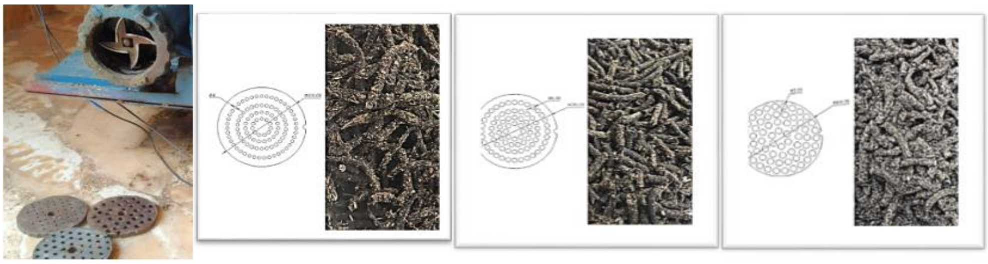


Figure 5. Die diameter 4, 6 and 8 mm.

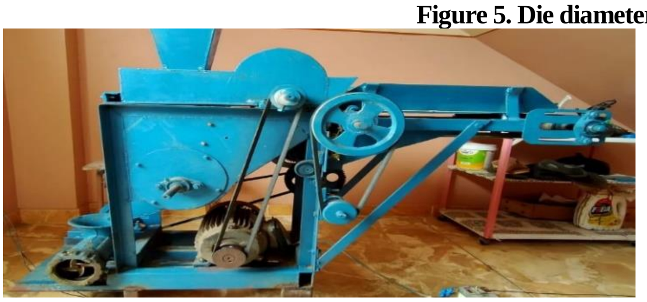


Figure 6 .The fabricated machine(side view)

Figure 7 .The fabricated machine(front view)

Instruments

UNIT-T UT371 Tachometers ranged from 10 – 99999 rpm was used for measuring speeds. To determine the mechanical properties of pellets, a proprietary tension/compression testing machine (Instron Universal Testing Machine/SMT-5) was used; which was equipped with a 500 kg compression load cell and an integrator (Saiedirad *et al.,* 2008). The measurement accuracy was ± 0.001 N in force (Figure 8).

Shear force | **Rupture force (vertical orientation)** | **Rupture force (horizontal orientation)**

Figure 8. Universal material tester

The individual pellet was loaded between two parallel plates of the machine and compressed along with thickness until rupture occurred. This was denoted by a rupture point in the force – deformation curve. The rupture point is a point on the force – deformation curve at which the loaded sample shows a visible or invisible failure in the form of breaks or cracks. This point is detected by a continuous decrease of the load in the force - deformation diagram. While the rupture point was detected, the loading was stopped. These tests were carried out at the loading rate of 5 mm/min for all moisture levels (ASAE, 2006). The mechanical behavior of rabbit feed was expressed in terms of shear force and ruptured force. Three replications were made for each test. An electrical balance sensitive scale with an accuracy of 0.01 gm. was used to measure the mass of the samples.

Study of performance parameters

All experiments were performed under the following variables:

-Three different moisture contents of sprouted barley (70.09, 79.71 and 81.35%).

-Three die diameters (4, 6 and 8 mm).

-Three mixing duration times of (10, 15 and 20 min).

Measurements

To determine the optimum conditions for the machine under study, the following criteria were studied:

1) Moisture content: The moisture content (d.b., %) were determined by oven method. About five grams of samples were placed in a shallow aluminum dish and dried for 22 hours at 130°c. At the end of this time the constant mass showed that all moisture was driven off.

$$M.C._{d.b.} = \frac{W_i - W_d}{W_d} \times 100 \quad \textbf{(1)}$$

Where

M.C $_{d.b.}$ = Moisture content, dry basis, %.
W_i = Initial mass of sample, g.
W_d = Dried mass of sample, g.

2) Bulk density: It was determined according to ASAE (2003). Samples were taken to determine their mass and volume. The bulk density was calculated as the ratio of the bulk mass and the volume of the container.

$$\boldsymbol{\beta = m/v, \quad kg/m^3} \qquad \textbf{(2)}$$

Where:

β : is the bulk density of the material , kg/m^3
m: mass of material in kg, and
v : volume of the container in m^3

3) The machine productivity: The productivity of the pelleting machine was determined with the help of a digital stopwatch of 0.1-sec. accuracy and an electrical balance of (0.0001g) accuracy. Machine productivity (pelletizing capacity) (P, kg/hr) was calculated as follows (Regupathi *et al.* 2019):

$$P = \frac{W_{out}}{t}, kg/h \longrightarrow (3)$$

Where:

t = time of test duration (hr.).

4) Pelletizing efficiency: The pelletizing efficiency (*ηp.*), % is the ratio between the quantity of feed pelleted and the total feed input (Okolie *et al.* 2019). It was determined for 1 kg of feed meal using the following relationship:

$$\eta_p = \frac{W_{out}}{W_{in}} \times 100 \quad \rightarrow (4)$$

Where:

W_{out} = Weight of output pelletized feed, kg, and,
W_{in} = Weight of total feed input, kg.

5) Energy requirement: Energy requirement in kW.h/Mg was calculated using following equation (El-taher *et al.* 2013).

$$\textbf{Specific Energy} = \frac{\boldsymbol{P_R}}{\boldsymbol{P}} \rightarrow (\mathbf{6})$$

Where:

P_R=Required power, kW.
P =Machine productivity, Mg/h.

6) Chemical analysis: The chemical analysis is one of the most important tests that are conducted on the feed to evaluate and know the proportions of the components needed by the animal. One of the most important of these tests is to know the percentage of protein present in the pellets, ASH, moisture content and fats.

RESULTS AND DISCUSSION

Factors affecting bulk density, Kg/m^3

Figure 9 shows the effect of moisture content, die diameters and mixing duration times on bulk density.

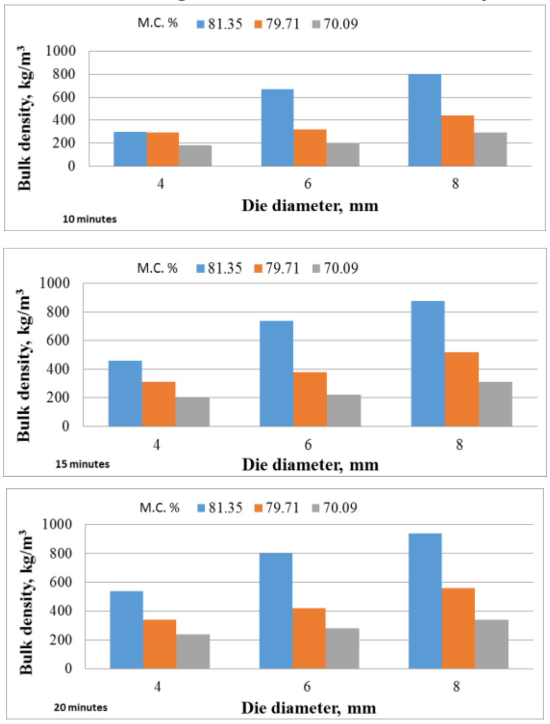


Figure 9. Effect of die diameter (mm) on bulk density (Kg/m^3).

It was observed that the bulk density decreased by increasing moisture content, while it increased by increasing mixing time and die diameter. The maximum value of bulk density was 940±1.2 Kg/m^3 at die diameter of 8 mm, mixing time of 20 min and moisture content of 70.09 %. The minimum value of bulk density was 180±0.7 Kg/m^3 at die diameter of 4 mm, mixing time of 10 min and moisture content of 81.35%. Higher density could be as a result of the good mixing of the components, the pellets are more compressed, which leads to an increase in its mass and thus an increase in the apparent density. It was noticed that bulk density, Kg/m^3, % increased with the moisture content, %; die diameters, mm; and mixing duration time according to the following descending order [81.35<79.71< 70.09, %]; [4< 6<8 mm]; and [10< 15<20 mm], respectively.

Factors affecting shear force, N

Figure 10 shows the effect of moisture content, die diameters and mixing duration times on shear force.

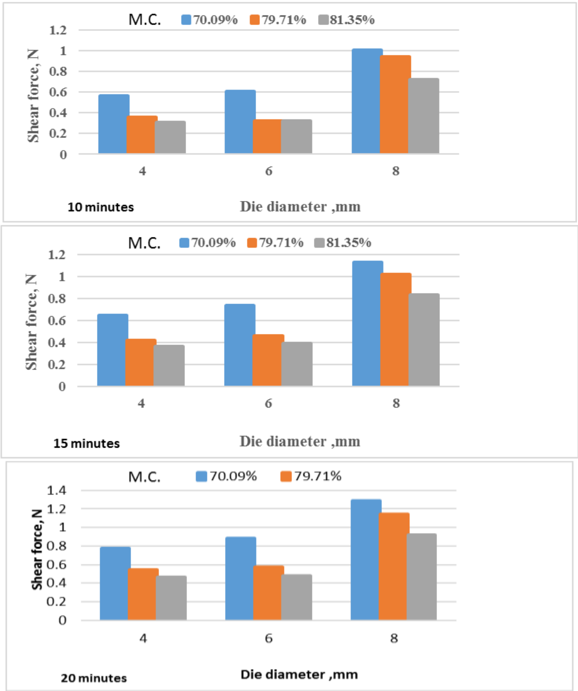


Figure 10. Effect of die diameter (mm) on shear force (N).

It was observed that the shear force decreased by increasing moisture content, while it increased by increasing mixing time and die diameter. The maximum value of shear force was 1.29±0.02 N at die diameter of 8 mm, mixing time of 20 min and moisture content of 70.09 %. The minimum value of shear force was 0.31± 0.04 N at die diameter of 4 mm, mixing time of 10 min and moisture content of 81.35%. It was noticed that shear force, N, % increased with the moisture content, %; die diameters, mm; and mixing duration time according to the following descending order [81.35<79.71< 70.09, %]; [4< 6<8 mm]; and [10< 15<20 mm], respectively.

Factors affecting rupture force, N

Figure 11 shows the effect of moisture content, die diameters and mixing duration times on rupture force. It was observed that the rupture force decreased by increasing moisture content for vertical and horizontal orientation, while it increased by increasing mixing time and die diameter. The maximum value of rupture forces for horizontal and vertical orientation were 8.72±0.05 and 6.32±0.03 N at die diameter of 8 mm, mixing time of 20 min and moisture content of 70.09 %. The minimum value of rupture forces for horizontal and vertical orientation were 1.01±0.04 and 0.94±0.07 N at die diameter of 4 mm, mixing time of 10 min and moisture content of 81.35%. It was noticed that rupture force, N, % increased with the moisture content, %; die diameters, mm; and mixing duration time according to the following descending order [81.35<79.71< 70.09, %]; [4< 6<8 mm]; and [10< 15<20 mm], respectively.

Vertical -10 minutes

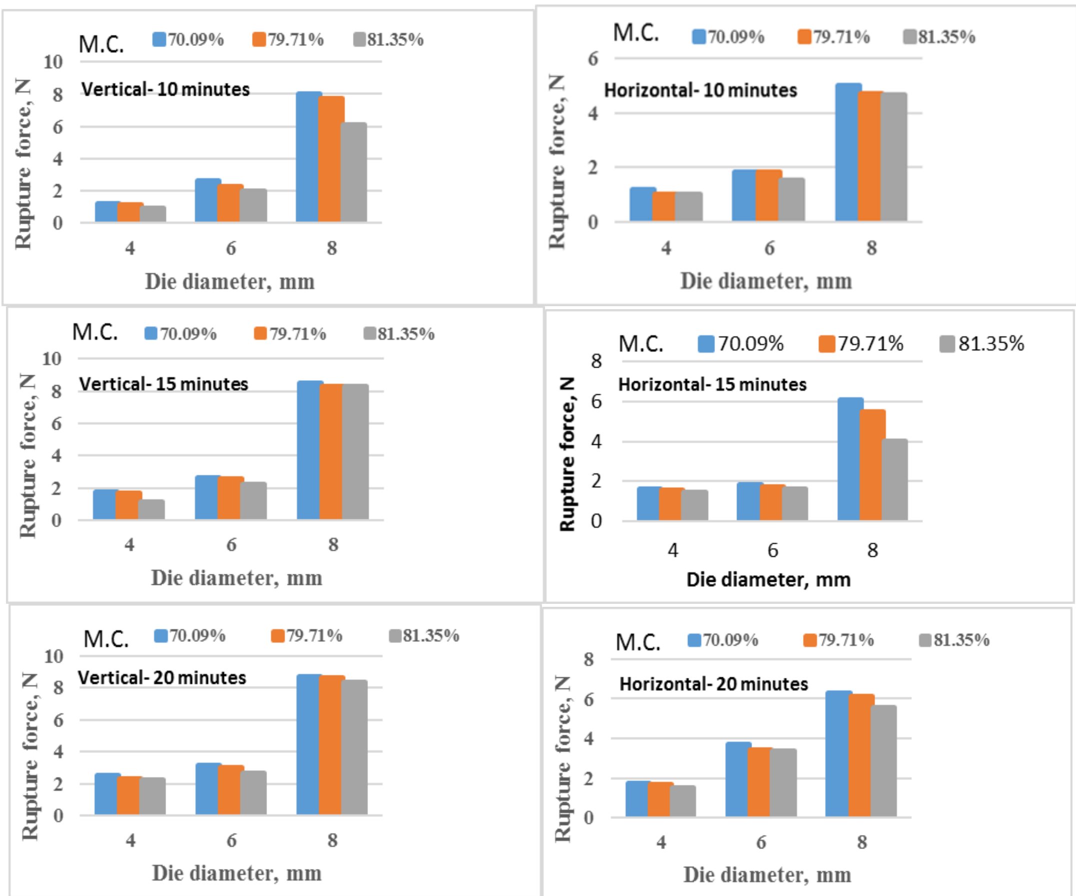


Figure 11. Effect of die diameter (mm) on rupture force (N)

Factors affecting machine productivity, kg/hr

Figure 12 shows the effect of moisture content, die diameters and mixing duration times on machine productivity. It was observed that the machine productivity increased by increasing moisture content, mixing time and die diameter. The maximum value of machine productivity was 66±3.31 kg/hr at moisture content of 81.35 %, die diameter of 8 mm and mixing time of 10 min. The minimum value of machine productivity was 20.1±2.05 kg/hr at moisture content of 70.09 %, die diameter of 4 mm and mixing time of 20 min. It was noticed that machine productivity, kg/hr increased with the moisture content, %; die diameters, mm; and mixing duration time according to the following descending order [70.09<79.71< 81.35, %]; [4< 6<8 mm]; and [20< 15<10 mm], respectively.

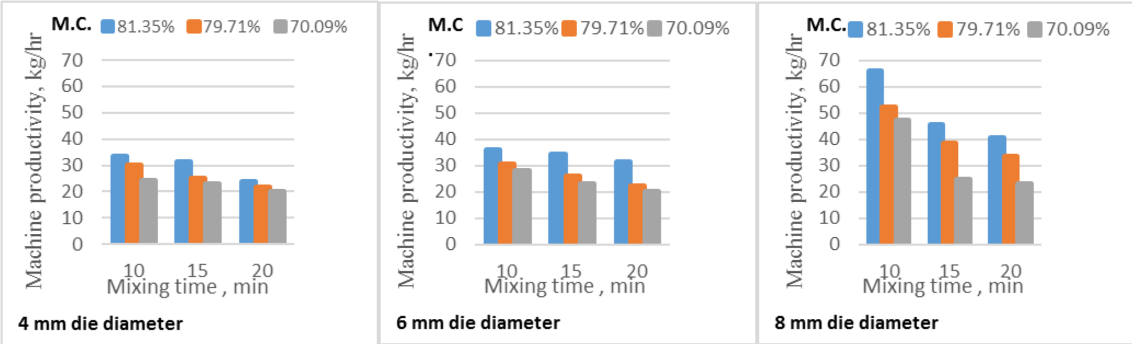


Figure 12. Effect of mixing time (min) on productivity (kg/hr).

Factors affecting mixing efficiency:

Figure 13 shows the effect of moisture content and mixing duration times on mixing efficiency. It was observed that the mixing efficiency increased by increasing mixing duration times, while it decreased by increasing moisture content. The maximum value of mixing efficiency was 95.2±6.77 % at mixing time of 20 min and moisture content of 70.09±3.21 %. The minimum value of mixing efficiency was 63.1% at mixing time of 10 min and moisture content of 81.35 %. It was noticed that mixing efficiency, % increased with the moisture content, % and mixing duration time according to the following descending order [81.35<79.71< 70.09, %]; and [10< 15<20 mm], respectively.

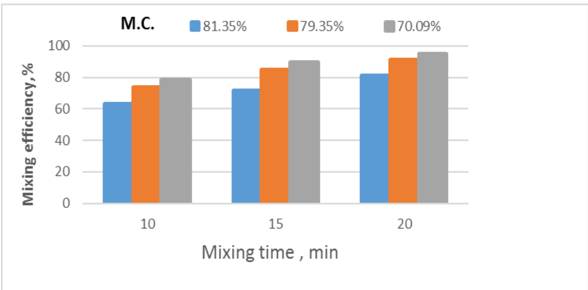


Figure 13. Effect of mixing time (min) on mixing efficiency (%).

Factors affecting pelletizing efficiency:

Figure 14 shows the effect of moisture content, die diameters and mixing duration times on mixing efficiency. It was observed that the pelletizing efficiency increased by increasing moisture content and mixing duration times, while it decreased by increasing die diameters. The maximum value of pelletizing efficiency was 97.9±4.67 % at moisture content of 81.35%, die diameter of 4 mm and mixing time of 20 min. The minimum value of pelletizing efficiency was 60.1±3.55 % at moisture content of 70.09 %, die diameter of 8 mm and mixing time of 10 min. It was noticed that pelletizing efficiency,% increased with the moisture content, %; die diameters, mm; and mixing duration time according to the following descending order [70.09<79.71< 81.35, %]; [8< 6<4 mm]; and [10< 15<20 mm], respectively.

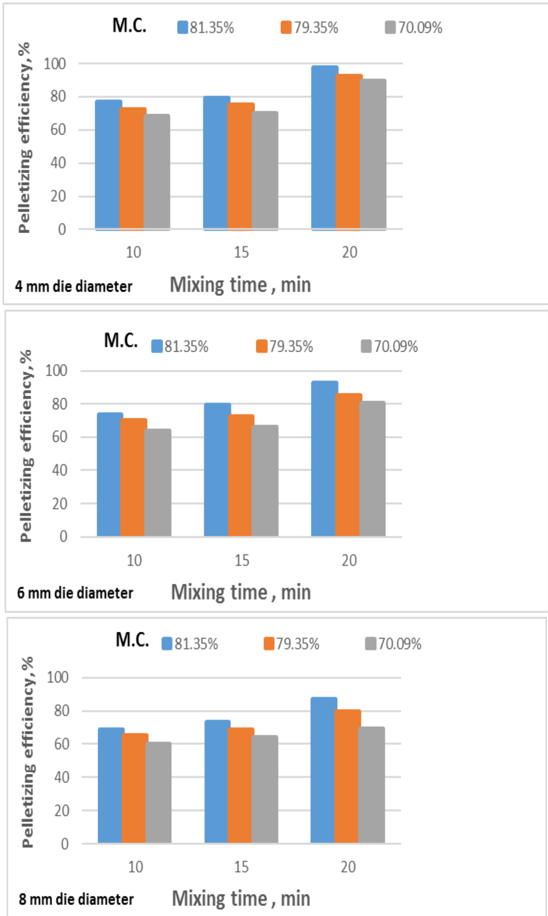


Figure 14. Effect of mixing time (min) on pelletizing efficiency (%).

Factors affecting specific energy requirement:

Figure 15 shows the effect of moisture content, die diameters and mixing duration times on specific energy requirement. It was observed that the specific energy decreased by increasing moisture content and die diameters, while it increased by increasing mixing duration times. The maximum value of specific energy was 109.45±11.11

kW.hr/Mg at moisture content of 70.09 %, die diameter of 4 mm and mixing time of 20 min. The minimum value of specific energy was 33.33±4.23 kW.hr/Mg at moisture content of 81.35%, die diameter of 8 mm and mixing time of 10 min. It was noticed that specific energy requirement, kW.hr/Mg decreased with the moisture content, %; die diameters, mm; and mixing duration time according to the following descending order [70.09<79.71< 81.35, %]; [4<6<8 mm]; and [20< 15<10 mm], respectively.

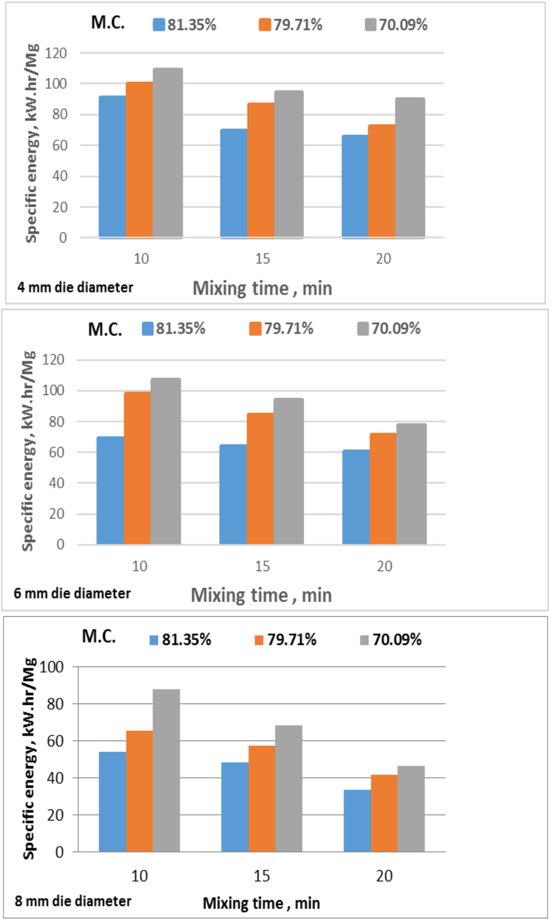


Figure 15. Effect of mixing time (min) on specific energy requirement (KW.hr/Mg).

Chemical analysis of the produced pellets:

Table 2 shows the chemical analysis of produced pellets. It is indicated that ash content was 9.1 %, protein was 21.26 % and fat was 1.98 %

Table 2. Chemical properties of pellets.

Test analysis	Test result
Moisture content %	9.23
Ash content %	9.1
Protein on wet WT%	21.26
Fat content %	1.98

CONCLUSIONS

The constructed alternative feeds making machine successfully proved its ability to chop, mix and pelletize raw materials to produce alternative fodder. To get higher values of bulk density, the developed machine needs to be operated at lower moisture content for sprouted barley with larger die holes' diameters and with longer mixing time. Deceasing die diameter and mixing time decreased shear and rupture forces at high moisture content for sprouted barley. Short mixing time of 10 minutes and larger die holes' diameters gives higher machine productivity and reduce the required specific energy at sprouted barley moisture content of 81.35 %. Produce durability indicates the ability of produced pellet to withstand physical disintegration with the ability to withstand compression and resist impacts during storage and transportation. Produced feed had 9.1 % ash content, 21.26 % protein and the fat percentage was 1.98 %.

REFERENCES

Abubakre, O. K.; A. B., Garba and H.Tukur (2014). Design and fabrication of model feed pelletizer. In Applied Mechanics and Materials (Vol. 533, pp. 64-67). Trans Tech Publications Ltd.

ASAE (2003). Moisture measurement. American Society of Agricultural and Biological Engineers, ASAE Standard 352.2 FEB.

ASAE (2006). Compression test of food materials of convex shape. American Society of Agricultural and Biological Engineers, ASAE S368.4: 609-616.

Balami, A. A.; D. Adgidzi and A. Mua'zu (2013). Development and testing of an animal feed mixing machine. International Journal of Basics and Applied Sciences, 1(3), 491-503.

Church, D.C. (1991(. *Livestock Feeds and Feeding* .3rd ed . Englewood Cliffs: Prentice Hall.

El-Berry, A.M.; A. Baiomy; H.A. Radwan and E.M. Arif (2001) .Evaluation of)Hematol) machine in rice straw chopping .9th *Conference of MISR Society of Agricultural Engineering*, September 9-11, 2001, 65-76.

El-Iraqi, M .and S. El-Khawaga (2003). Design and test performance of cutting machine for some crop residues .*MISR Journal of Agricultural Engineering*, 20)1(, 85-101.

El-Taher, S. E.; M. S. El-Shal; M. M. A. El-Sharabasy and O. A. Kaddour (2013). Development of a pelleting machine for reducing the consumed mechanical energy. Zagazig Journal of Agricultural Research, 1163, 1182.

Fouda, T.; A. Elmetwalli; O. Kaddour; A. Derbala and K. Abdel-Mohsen (2015). Manufacturing and performance evaluation of a compatible unit to produce animal feed pellets. Scientific Papers: Management, Economic Engineering in Agriculture & Rural Development, 15(2).

Hoque, M.; S .Sokhansanj; L. Naimi; X. Bi and J. Lim (2007(. Review and analysis of performance and productivity of size reduction equipment for fibrous materials . *ASABE Paper Number: 076164*. Paper presented at ASABE Annual International Meeting Minneapolis, Minnesota.

Ighodalo, O.; S. O. Amiebenomo and T. Esabunor (2020). Optimization of multiple performance responses of a fish feed pelletizer machine. Journal of Advances in Science and Engineering, 3(1), 14-23.

Ikubanni, P. P.; O. O. Agboola; A. A. Adeleke; B. T. Ogunsemi and R. A. Ibikunle (2019). Fabrication and Evaluation of Screw-like Fish Pelletizer. In Journal of Physics: Conference Series (Vol. 1378, No. 2, p. 022076).

Khater, E. S. G.; A. H. Bahnasawy and S. A. Ali (2014). Physical and mechanical properties of fish feed pellets. Journal of Food Processing & Technology, 5(10), 1.

Leman, A. M.; R. A. Wahab; S. Zakaria; D. Feriyanto; M. C. M. Nor and S. Muzarpar (2017). The development of mixer macine for organic animal feed production: Proposed study. In AIP Conference Proceedings (Vol. 1885, No. 1, p. 020158). AIP Publishing LLC.

Mathers, J.O and E.O. Otchere (2012) .Research on the nutrition of working animal: needs, experiences and methods .*FAO Document*, p 9.

Naik, P. K. and N. P. Singh (2013). Hydroponics Fodder Production: An Alternative Technology for Sustainable Livestock Production against Impeding Climate Change. In: Compendium of Model Training Course Management Strategies for Sustainable Livestock Production Against Impending Climate Change', Held During November 18-25. Southern Regional Station, National Dairy Research Institute, Adugodi, Bengaluru,India, Pp. 70-75.

Ojomo, A. O.; L. A. S.Agbetoye and F. O. Ologunagba (2010). Performance evaluation of a fish feed pelletizing machine. ARPN Journal of Engineering and Applied Sciences, 5(9), 88-97.

Okolie, P. C.; I. C.C hukwujike; J. L. Chukwuneke and J. E. Dara (2019). Design and production of a fish feed pelletizing machine. Heliyon, 5 (6), e02001.

Orisaleye, J.; S. J. Ojolo and A. B. Fashina, (2009). Design and development of a livestock feed pelleting machine. Journal of Engineering Research, 14 (1): 1-9.

Regupathi, E. R.; A. Suriya and R. S. Geethapriya (2019). On studying different types of pelletizing system for fish feed.

Saiedirad M.H.; A. Tabatabaeefar; A. Borghei; M. Mirsalehi; F. Badii; M. Ghasemi and Varnamkhasti (2008). Effects of moisture content, seed size, loading rate and seed orientation on force and energy required for fracturing cumin seed (Cuminum cyminum Linn.) under quasi- static loading. J. Food Eng., 86(4): 565-572.

Zaki, R. I.; M. S. El-Shal and M. E. I. Radwan (2014). Effect of preconditioner operating parameters on the physical and chemical quality of extruded fish pellets. Zagazig J. Agric. Res, 41(4), 877-886.

تصنيع و تقييم آلة لإنتاج الاعلاف البديلة

أحمد محمد أحمد الشيخة[1] ، محمد علي إبراهيم الراجحي[2] وهاجر عامر محمد عامر[1]

[1]قسم الهندسة الزراعية ـ كلية الزراعة – جامعة دمياط

[2]معهد بحوث الهندسة الزراعية ، مركز البحوث الزراعية

يهدف البحث الي تصنيع آله لإنتاج أعلاف بديلة بطريقة بسيطة ورخيصة وبإنتاجية عالية وفي متناول المربي الصغير وذلك باستبدال حبوب الشعير الداخلة في مكونات العليقة بشعير مستنبت وذلك من اجل خفض التكاليف ولما يحتويه الشعير المستنبت من كمية أعلي من المادة الخضراء ونسبه مرتفعة من البروتين .وتشمل الاله المصنعة علي اربع وحدات رئيسية هي وحدة القدرة ونقل القدرة ووحدة التقطيع ووحدة الخلط ووحدة التصبيع. وقد تم اجراء التجربة لاختبار الاله المصنعة عند ثلاث مستويات من الرطوبة للشعير المستنبت (70,07 ، 79,71، 81,35 %) وثلاث اقطار مختلفة للداي (4، 6، 8 مم) وثلاث ازمنه للخلط (10، 15، 20 دقيقة). واوضحت النتائج ان الكثافة الحجمية المتوسطة هي 443,3 كجم/م^3 وان قوة القص المتوسطة 0,68 نيوتن وان متوسط قوة الكسر في الاتجاهين الراسي والافقي هي 3,04 ، 4,11 نيوتن علي الترتيب وان متوسط الانتاجية للألة 31,78 كجم/ساعة وان متوسط كفاءة الخلط 81,14 % وان متوسط كفاءة التصبيع 75,75 % وان متوسط الطاقة النوعية المطلوبة 74,47 كيلوجول.ساعة/ميجا جرام كما اثبت التحليل الكيميائي للمصبعات الناتجة ان نسبة الرماء 9,1 % ونسبة البروتين 21,26 % ونسبة الدهون 1,98 % لذا يوصي باستخدام الالة المصنعة لإنتاج الاعلاف البديلة.